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ABSTRACT

Teachers have acknowledged the richer learning environment and interactivity of multimedia teaching, its flexibility to different learning styles, and learner control that allows the learner to fully engage in the learning process. However, they still have problems in courseware design because their work is mainly centered on exercises and not on what the machine can do best. This is why a new audio segmenting device, called Virtual Recorder, has been derived from the LAVAC (Laboratoire Audio-Visuel Actif-Comparatif) toolkit to allow them to use videos. The video sequencer can complete real-time automatic segmenting of sound and images and automatically insert an answering time span after each sequence. Coupled to IBM ViaVoice, the teacher can speak during this time span to create the transcript from which the necessary textual help will be derived for easier aural comprehension. A 5-minute video requires no more than a few minutes' work from the teacher to produce a 2-hour student session. (Author/MES)

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Real-time courseware design : the LAVAC Video Sequencer®

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Abstract: Teachers have already acknowledged the richer learning environment and interactivity of multimedia teaching, its flexibility to different learning styles and a learner's control that allows him or her to engage fully in the learning process.
But they still have problems in courseware design because their work is mainly centered on exercises and not on what the machine can do best. This is why a new device has been designed to allow them to use their videos. The video sequencer can complete real-time automatic segmenting of sound and images and automatically insert an answering time span after each sequence.
Coupled to IBM ViaVoice, the teacher can speak during this time span to create the transcript from which the necessary textual help will be derived for an easier aural comprehension. A 5-minute video will then require no more than a few minutes' work from the teacher to produce a two-hour student session.

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Introduction

The aim of IT for a language teacher is to provide interactive simulations of language use through individual virtual learning environments. This highlights an important issue: the need for a particular multimedia learning system and courseware that will actually respond to specific user requirements.
Therefore when the first teacher-controlled multimedia computerized language laboratories appeared six years ago, the challenge was to enable teachers to use the built-in authoring system without any previous computer experience. Several easy-to-use programs with user-friendly interface have been developed to help them to digitize and edit sound, attach pictures and sounds to gap-filling or multiple-choice exercises, and achieve a multimedia integration that diminishes the weaknesses of each media used separately.
Such systems allow the design and development of a multimedia-based tutoring through embedded training packages and networked communication applications. They should offer learners' support, assessment tools and the maximum interactivity between teachers and students whether the teacher is present or not.
But if it is essential to know the possibilities of the system, it is even more important to define as accurately as possible the types of learning procedures that need to be implemented to help the teacher produce his own customized courseware and eventually a powerful interface for learning.

Objective

The building-up of knowledge representation and learning will occur through some proposed tasks but these tasks should be appropriate to a maximum number of cognitive learner types (analytic, synthetic, kinesic, etc.). The problem is then to implement the metalinguistic learning activities that will suit these different cognitive types knowing that each learner more or less belongs to most or all of these types.
Several solutions can be proposed among which a hierarchized list of different deduction techniques for sound recognition and understanding, i.e. wave spectrograms, phonetic transcription, lexical hints, written form of words and translation. Etymology, knowledge of the discourse situation, contextual logic will be put into use to enable the learner to find the meaning of the words or the group of words by him or herself.
Everything should be designed to help and encourage the learner to carry out his or her tasks alone, with imposed hints if necessary for all of them and proposed ones only for those who need them.
Keywords in multimedia teaching are learner's control, hypernavigation, interactivity, and multimodality. But learner's control does not certainly mean no-time limit to answer nor an easy access to the solution. The problem

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is that most courseware programs leave the learner free to read the solution just after a mouse click or to read the transcript on an aural comprehension task[1].

As a cognitive scientist and a linguist, I have therefore designed the implementation of ten fundamental prerequisites for a multimedia language authoring system:

1. multimediatizing or the use of the multimedia language directly from a didactized content of information the teacher will have in **mind**. Detailed design will be achieved through doing
2. multimedia expression through a coherent semiological code and a multimedia language still to improve and stabilize
3. easy-to-use authoring system for non-programming teachers
4. adaptation of the produced software to different cognitive types
5. adaptation of the produced software to different personality types
6. set of hints that will implement metalinguistic activities based on deduction techniques, so that the mental processes involved can be reused in other linguistic contexts
7. automatic segmenting with answering time and segment visualization
8. personalized access to the solution decided by the teacher in relation with the learner's metacognitive performance
9. presence of the teacher in the room for personalized tutoring while the learners work on the machines and communication activities in small groups still in the same room
10. possibility of real-time modifications for answering time, textual hints, questions or even mistakes ... on the part of the teacher.

Methodology

The implementation of these pre-requisites began in 1992 when I designed the LAVAC® (Toma, 1993). This acronym stands for *"Laboratoire Audio-Visuel Actif-Comparatif"*, i.e. Audio-Visual Active-Comparative Laboratory. Its development is still under way with an html version, but the decided objectives are now reached with the latest version (4.03.i).

LAVAC has become one of the most popular computerized language laboratories in France since 1993, with around 5 000 software programs used in more than 150 university departments and high schools in France and abroad.

The system consists of a complete network of student terminals, plus a courseware-design workstation, all linked to a server. It was the first to use a teacher's console for presential or distance tutoring, which avoids the well-known 'wandering' and twisted paths of a learner lost in a traditional Resource Center.

A LAVAC courseware is in fact a set of segments or sequences with an automatically-given number plus a possible name or wording of your choice, linked to sound, images, videos, texts and tutor zones (for proposed hints or exercises), making it up to **six** different media altogether.

This has mainly been designed for oral comprehension and production, i.e. for listening (with 24 listening modes) and recording, but the student can also type in his answers, either in a learning or testing mode, and will be guided by hypertext or hypermedia links in case of mistakes.

The problem is that this tool may have been designed too early. Teachers were not ready yet. As Carlson (1998) puts it: "A technology-enabled curriculum should be conceptualized as a dynamic partnership among three agents: the student, the teacher, and the computer-mediated tools". Six years ago, few students knew how to use a computer and a lot of training was needed. Furthermore, the expensive machines (PC 386) were slow in playing the wave files which had to be short especially because these files were provided by a distant server through a Novell network. The network nevertheless was the only solution to overcome the low capacity of disks (540 Mb) and enable discrete or active tutoring.

The three agents were not present at that time, but now the situation has changed. Students have become familiar with cheap machines powerful enough to play real-time full-screen videos in a 100 Mbit Windows NT network.

Are teachers a problem? Most observers see them as conservative and technophobic. But this so-called negative attitude and the difficulty to educate teachers who, as educators themselves are sometimes the last persons to accept to be educated, should not be overemphasized, simply because teachers, and not the industry, are at the heart of the system.

The main problem with teachers is that they see multimedia as a "combination of texts, audio, and pictures on a single platform. At its best, it should recombine the benefits of 'conventional' Computer-Assisted Language Learning (text reconstruction exercises, tests games, etc.) with those of videos, together with the advantage of

[1] See Toma, T. (2000).*Cognition and Courseware Design by Teachers: the Concept of Multimediatizing*. SITE 2000, San Diego, Ca, for a more complete description of the present situation.

being able to jump instantly to the desired frame rather than having to rely on the rewind or fast-forward keys" (Eastment, 1999). Eastment synthesizes the problem and its solution in this comment.

The problem is to believe that multimedia courseware design just consists in digitizing different media already edited in a discrete way and in integrating them with an authoring system, even if as with LAVAC no programming is required (for at least 99% of the functions). The question for the teachers is *how* to integrate the different media. A complete rethinking of their pedagogical practices has to be undertaken. Some are ready for it, some are not. The need for bringing "conventional" teachers into computer-literate ones has well been developed in Nierderhauser (1996), but few training courses integrate an epistemological thinking on the changes involved in the didactic practices (Toma, 1997).

Few training courses explain as well that integration should not be carried out in the "ancient" way (still in use however) which consisted in giving scripts, audio and video cassettes, exercises on paper to team of developers that usually, because they are not teachers, have difficulties in understanding the specific teachers' requirements and produce a result often far from the one expected.

This is why I imagined the concept of multimediatizing[2] which consists in the *direct* expression of a didactized content into a multimedia form. No storyboard is needed with the LAVAC system since for language teaching the privileged medium is SOUND. The automatic segmenting of the sound track will produce numbered sequences where text, image, exercises can be attached to if needed.

That is why the solution is in the use of what the machine can do best. Sound processing in LAVAC is real-time and the minimum pedagogical work on behalf of the teacher is to write the transcript and analyze the lexical and syntactic difficulties for his or her specific students. Help will be given in the corresponding text zones and images will be linked to the right sound segment as a prop to the discourse situation. Links are created by a simple mouse click.

Exercises are often difficult to implement with an authoring system. Ironically enough the most profitable ones are not the easiest to complete. The first one is note-taking that can be done on a simple sheet of paper or in a text zone very easy to create. This phase can be labeled "content appropriation" phase.

Then in the testing phase exercises will have to be taken and done with the notes (with possible comebacks to the informational content).

The first exercise is a written question one with open answers. An answering text zone has just to be linked to the sequence labeled "Exercise 1" and this zone will open when the student will select "Exercise 1" and click on "Record". The written answers are immediately recorded on the server for an instant retrieval in case of modifications or analysis by the teacher.

The second exercise is a transcription of a passage of the sound track. It is just the same as note-taking but all the words have to be written. A gap filling-exercise could then be easily set up with a blank for all the words or just for some that need to be tested but a transcript on papers that can be given to the teacher proved as effective since the point is not to know that a word has been badly understood, but to understand why. Students really demand the teacher's opinion on their problems just because they can see the teacher has more time for themselves.

The third exercise is a so-called "simple" exercise since it is a repetition of a part of the sound track. It is automatically implemented by LAVAC since a recordable answering time span is set by default after each segment. But this task is not so easy for the learner since he has to discriminate the words, understand them, remember them and pronounce them in a limited time

The fourth exercise consists in oral questions that have to be answered orally. Here the sequences are manually created by a mouse click, the question is recorded by the teacher and he decides upon the length of the answering time span by entering a number of seconds.

The fifth is a translation exercise, which is from a computer point of view exactly the same as the first. The teacher types the sentence to be translated and creates an answering zone. The students' written answers will then be automatically saved in their respective files.

Most teachers use this model even if gap-filling or multiple-choice questions are also possible.

However the majority of teachers who discover multimedia teaching, who agree to use multimedia on the condition that they produce their own educational software because the available programs on the market are too general and will not satisfy their didactic needs, still do not know what to do since they think they will not have time to learn how to use even simple tools.

For this reason, I designed a new system derived from LAVAC that presents a new student interface of the LAVAC audio-segmenting device that will avoid teachers to link text or images to the sound segment.

This device, called *"Virtual Recorder "*®, is an audio-sequencer and appeared in 1998. The problem was even more complex with videos.

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[2] See again Toma, T. (2000).*Cognition and Courseware Design by Teachers: the Concept of Multimediatizing*. SITE 2000, San Diego, Ca.

Automatic segmenting of the sound AND the images was not easy to achieve for synchronization reasons between these two media. Moreover the sound volume is sometimes kept constant due to music background on some videos. Since automatic segmenting works by the detection of blanks or volume drops in the sound signal, this problem of background music had to be overcome. This video-segmenting device or "*Video Sequencer* "[3] appeared then in March 1999.
Training for teachers is thus shorter. An exercise sheet can even be given to each student at the end of their lab session. Exercises can be done at home and the correction will take place in a normal classroom. If students spend less time in the language lab a greater number of them will be able to use it.
The methodology described here can therefore fit different didactic contexts. Three software tools can thus be used: the complete LAVAC software (authoring system, student interface, teacher interface (for distance tutoring), networking tool program for complete multimedia courseware, the audio-sequencer and the video-sequencer both compatible with the LAVAC student interface.

Results

Many teachers have produced several educational programs with this methodology by using the complete LAVAC toolkit (Toma, 1996). Tests have occurred for six years now with an average of 300 students a year.
Students appreciate the possibility of retrieving their recordings (text or sound) more than attractive exercises that are mainly complex to build. They sometimes consider the teacher as a tool when they urgently need him or her in case of a problem, but most of the time as a guide and a confident for their own particular problems.
Experiments are still in progress with the audio and the video sequencer, so I would like to limit the results to the use of the audio segmenting device, the use of the video sequencer alone, and the use of this tool with IBM ViaVoice and the LAVAC courseware station.

The LAVAC segmenting device

The segmenting device needs first to make a distinction between what is language sound and what is not. This can be set on 1-127 scale. A high level will be used if the background noise is important. At a value of 30 segmenting still takes place but the words have to be pronounced loud, if not they might be interpreted as noise. A value of 5 is used in a quiet environment. Under 5 it has to be very quiet. The computer noise may then be interpreted as language and therefore no segmenting will occur since it is continuous!
The normal values will then vary between 5 (quiet) and 15 (rather loud).
The next setting will concern the value of the blanks to be detected. This setting can vary from 0.2 second to 8 seconds. A "hard" segmenting rate of the sound track at a value of 0.2 second will give a large number of short sound segments (one word or more) to suit weak levels of students whereas a medium rate of 0.5 second will give a smaller number of longer sound segments for average-level students. Values above 1 second will be used to segment a sound track in large paragraphs.
Another setting concerns the value of the answering time span created after each segment during the segmentation process. The length of this span will be proportional to the length of each created segment. The proportional value can then be parameterized in a 10 to 999 % range. I usually use a 150 % value for repetitions, which means for instance that there is a 3-second answering time after a created sound segment of 2 seconds. But if this answering time is used as an automatic pause in aural comprehension for a better understanding process (because slower) and for note taking, the value should preferably be set at 3 to 400%.
The digitizing of the audiocassettes of the old cassette labs has also been planned. At a 100% value, the duration of the recorded blanks of the cassettes (corresponding to the answering time spans) are respected. But teachers find it necessary to diminish the values of the blanks simply because the student language level has raised. A complete recording of the cassette would be necessary with a traditional recording system either analog or digital. With this system, the recording of the cassette can be done in real-time in the server with a different value of the time spans. On top of that if the new value proved unsatisfactory, it can be changed while the students are working on the network[3].
The video segmenting device uses these LAVAC parameters except for the audio cassette settings.

The student videosequencer interface[4]

[3] A screen image could have explained more than words these different settings. They cannot be inserted here in a 6 page article. Neverthelesse these explanations are available with images on my ftp site: ftp://130.120.112.2/Tony/San_Diego
[4] For more details on the system see http://www.alizes.fr/cp3j

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The *Video Sequencer* uses the whole set of didactic prerequisites this time applied to an analog VHS recording a an analog or digital camcorder recording or a live satellite program.
When the video starts to be digitized, it can immediately be seen on each student monitor. Sound is heard but no student control is possible. Nevertheless, if a student comes late, he will see and hear the video from the beginning and not from the part that is being digitized when he arrives. Or if a weak level student thinks he will not have enough time to understand more than 3 minutes of video, he can stop the visualization for a while and resume it after, when the first part has been completed.
For a better data transfer through the network, the AVI file sent to each student PC is MJPEG compressed (about 7 times).
The interest of the system is that segmenting occurs during this data transfer but is not visible when the video is played for the first time. As soon as digitizing is finished, the system automatically turns itself into the segmenting mode.
The segmented video immediately starts on the recording mode. Experience has shown that a learner will tend to watch the video intuitively as on television, which may induce a passive attitude. On the contrary, the recording mode shows that the machine waits for an action on the part of the learner. The first segment is played with sound waves in green on the "teacher" track, and after the first segment a red line appears which is the sound track of the student when s/he does not speak. As soon as the student speaks, waves appear in red. But if he does not, the video goes on and the second sequence is played. The video will thus be automatically paused, which will favor a better understanding and note taking.
Unexpectedly, most students stop the video after three or four sequences have been played, just to see the "menu" of their work. Each segment is numbered and represented by a square on a line. It is then possible, using the direction keys, to move rightward or leftward on this line, or to go straight to the end or the beginning by pressing the appropriate keys. In fact they want to be aware of the average length of each segment since 60 segments for a 3-minute video will be much easier to listen than 10.
In each square small lines appear in different colors according to the status of the segment: yellow for non-played segment, green for a played segment, red for a recorded one and green under the red when the listening of a recording has been made.
One of the most used trick is to click inside the sound wave to insert an index from which the video starts immediately and tirelessly. After each click of the mouse a vertical black line will come up in the yellow line. These indexes set by the students will help him find back the segments which posed comprehension problems to him. He will not need then to jot their number down for an easier retrieval. A recap key will help him play the segment at the place of the index when necessary.
The pedagogical interest of sound waves were questioned at the beginning. Some teachers even saw them as a gadget. I even had this dubious attitude. But English pronunciation is so stressed compared to French that this first forced students to speak louder in their microphones to make their spectrograms as accentuated as the master track's, and second, their could visualize sounds that they would have noticed otherwise. Even when they still do not understand it, they can make the difference between what is understood and what is not.
Three "working" modes have then been implemented to increase the range of learning tasks: teacher then student (sequential mode) for recording, teacher and student simultaneously (but in the recording mode, this would mean that the student knows the transcript by heart), and role play (in that case, the student can answer freely to questions asked if s/he takes the role of the interviewee, or know them by heart if s/he takes the role of the interviewer. Role play is the favorite activity of the students because they suddenly have the feeling of becoming part of the video (at least their voice)!
Another surprising result concerns the listening of students' recordings in the sequential listening mode. The LAVAC setting reproduces the classical model of the language lab: teacher listening, student recording, teacher's correction, student's repetition of correction. I chose a different option for the video sequencer. After the recording phase, the listening phase starts with the student's recording and not the teacher's one. Tests proved that students were much more attentive to the teacher's production (the master track in that instance) after they have heard their production than in the opposite way. The reason for that still needs further checking, but it seems that the student is first eager to hear his or her recording. If he hears the teacher's track first, he will not listen to all since he is awaiting his production. When he has heard him or herself, he is more prone to listening to the right pronunciation, so that s/he will become more conscious of the distance between both productions and will immediately try to diminish it.

The teacher videosequencer with IBM ViaVoice and the LAVAC courseware station.

After a real time segmenting, the teacher has just to repeat each segmented part of the sound track in the following blank created by the system. Words are then written by Via Voice in a special window with a 90% accuracy but the silence in the recording room must be total.

A LAVAC lesson has first been prepared and copied as a model. Hints can then easily be made from the transcript and pasted in a window of the corresponding LAVAC sequences.
Students will therefore be able to type their own transcript using the aids. This transcript can be visualized by the teacher through the network and when sufficient work has been accomplished by the student, the correction can be sent to him or her.
All links to a database for vocabulary, grammar, or civilisation purposes can eventually be made, with the necessary connections to the Net.

Conclusion

More than 5 000 LAVAC software programs are being used in French universities. A number of experimental protocols are still in progress mainly carried out by cognitive scientists. The video sequencer seems to be the easier and more efficient tool to use for non-programming teachers.
At least this is perhaps the solution to engage them later in a full courseware design process.

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